

Inventor: MATTINGLEY ET AL
Serial No.: 10/520,943
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Examiner: Michael Bernshteyn
Group Art Unit: 1713

REMARKS

The Office action of November 15, 2005 has been carefully considered and the application has been amended accordingly.

Claims 1-13 are present in the application. Parent claim 1 has been amended, and dependent claims 9-13 also have additional amendments thereto. The basis for the amendment to claim 1 is found on page 5, lines 26-27 of the specification. The basis for the amendments to claims 9-13 is found on pages 1 and 2 of the specification.

Claim 1-7 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Kronfli et al. in view of the application to Coowar et al.

The examiner has acknowledged that Kronfli et al. does not disclose that the boiling point of the non-solvent is higher than that of the solvent (cf. step a) of claim 1), and the use of octanol, decanol, dodecanol or a mixture thereof (cf. claim 4).

A further distinction is that Kronfli et al. does not cast from a solution (cf. step c) of claim 1). Rather, Kronfli et al. describes casting from a slurry. Thus, on page 11, claims 11-21, the citation describes preparing a solution and then adding

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LiClO₄, ethylene carbonate, graphite, acetone and further NMP, followed by stirring and heating. This is described at line 17 as "the resulting slurry" and this is what Kronfli et al. cast and dry. It is inconceivable that the slurry gives rise to a porous polymeric membrane in the sense of the present invention.

A still further distinction is that Kronfli et al. does not describe holding the solution at a temperature of at least 40°C until the polymer is completely solvated as recited in (step b) of claim 1). Kronfli et al. merely state that NMP and DMA were added "to dissolve" the PVdF (page 11, line 13). They clearly have no appreciation of the criticality and importance of the conditions of this step, and there is nothing to suggest that, in Example 3, they achieved complete solvation. Applicants' examples demonstrate how difficult it is to achieve complete solvation, which is very important when making porous polymeric membranes of the required quality. Thus, in Example 1 of the present application, stirring for 1 day at 55°C and maintaining at 55°C for 6 further days is required. Page 6, lines 10-11 of the present application emphasizes the requirement for complete solvation.

Page 6, lines 20-23 explain that gel formation in the present invention is so slow as to be negligible during the

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solvation process, which occurs without the formation of a microgel.

The Examiner should be aware that the Kronfli et al. citation contains five examples that describe casting of PvdF-containing mixtures. All involve mixing the polymer, various solvents and sometimes other ingredients, stirring and heating the mixture and then casting to form a film. In only one example (Example 3 discussed above) is a dispersion in a non-solvent made before adding a solvent. Kronfli et al. therefore ascribe no particular significance to Example 3; the use of methanol therein, stated to be in a "small" volume (i.e., not quantitatively in contrast to claim 1, amended as above), would be regarded by the skilled reader as a merely incidental description.

Coowar et al. reverse the order of addition of solvent and non-solvent defined in step (a) of Applicants's claim 1.

As described in paragraph 00013 of Coowar et al., PVdF is dissolved in DMF (a solvent) and 1-octanol (a non-solvent) added to the solution. However, Coowar et al.'s order of addition creates problems: the paragraph bridging pages 4 and 5 of the present specification states that a microgel is generated, so the

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solution is unstable and does not give reproducible membranes.

The Examiner contends that both references concern obtaining porous membranes for cells. In fact, Kronfli does not mention membrane porosity, and any occurrence thereof in carrying out the teaching of Kronfli et al. would be purely incidental. The Kronfli et al. citation is directed towards polymer chemistry, i.e., improving polymer properties by grafting a mono-unsaturated carboxylic acid, ester or amide thereon. Coowar et al. is directed to providing physical properties in a porous membrane.

There is therefore no reason why the person of ordinary skill in the art should contemplate substituting octanol (as described in Coowar et al.) for methanol (in Example 3 of Kronfli et al.) if he or she wished to obtain membranes of controlled porosity.

Even if, assuming *arguendo*, such substitution were made, the present invention would not be achieved. Key parameters for attaining porosity control, defined in the present claim 1, are still absent: the requirement in step b) for complete solvation, and the requirement in step c) to cast from a solution rather than from a slurry.

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Applicants respectfully disagree with the Examiner's contention that Kronfli et al. describe the limitation of claim 5 on page 6, lines 32-34. Claim 5 recites that "the solution is solvated for up to 14 days." Thus, claim 5 is a limitation of step b) of claim 1. Page 6, lines 32-34 of Kronfli et al. state that the solution was left for 5 days for the casting solvent to evaporate leaving a film. Kronfli et al., in this respect, therefore relates to step d) of claim 1, page 6, line 31 of Kronfli et al. making clear that dissolution has taken place before pouring into the dish for the solvent to evaporate. The Examiner's contention is not therefore accurate..

In the paragraph bridging pages 5 and 6 of the Office action, the Examiner states that evidence indicating criticality of features such as duration, concentration or temperature is required.

As noted above, the Examiner appreciates that methanol (non-solvent) as used by Kronfli et al., has a lower boiling point than the NMP (solvent) used by Kronfli et al., i.e., in contrast to the present invention. This means that in the drying step of the citation, the methanol (non-solvent) will tend to be removed before the NMP (solvent), whereas, in the drying step of the present invention (step d)), the non-solvent will tend to be

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removed after the solvent. Bearing in mind that an object of the present invention is to produce a membrane having desired porosity, the influence thereon of the order of removal of solvent and non-solvent is significant. Thus, as solvent is removed before non-solvent in the drying step of the present invention, the concentration of polymer relative to non-solvent increases, thereby favorably influencing the porosity properties of the resulting membrane in comparison with Kronfli et al..

The practice in the art, when seeking to make porous membranes from a solvent: non-solvent system, is to employ a non-solvent having a higher boiling point than the solvent. This demonstrates that Kronfli et al. is not concerned with porosity of membranes and that the skilled person in the art wishing to make porous membrane would not pay regard to the Kronfli et al. citation.

The significance of temperature in assuring complete solvation is discussed from page 5, line 34 to page 6, line 23 of the description. As stated at page 6, lines 11-13, exact time varies depending on the solvent/non-solvent mixture, the choice of polymer(s), and the temperature. Importantly, complete solvation has to be attained otherwise concentrated polymer "lumps" will be present and appear in the final product, thereby

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preventing the desired porosity from being produced.

Claims 1-4 and 6-8 were rejected under 35 U.S.C. 103(a) as being unpatentable over Coowar et al.

Applicants agree that the present invention requires dispersing the polymer in the non-solvent prior to addition of the solvent, whereas Coowar et al. add non-solvent after the solvent. But this order of addition is significant in that it determines what physical form is present at the end of the first addition of either solvent or non-solvent.

Thus, after the first addition, a slurry is present in the present invention, while a solution is present in Coowar et al.. Therefore, in the invention, solvent is then added to a slurry, and non-solvent then added to a solution in Coowar et al.. Thus, comparing the present invention with Coowar et al., there exists a difference in physical form at different stages in the addition of non-solvent and solvent, depending on the order of addition. The person of ordinary skill in the art would not, on the basis of the prior art available, have predicted that an improvement in porosity properties would be achieved by reversing Coowar et al.'s order of addition of solvent and non-solvent having also ensured also that complete solvation is effected. There is no motivation or indication in the art that the skilled person

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should have carried out the process steps defined in the present claims in order to improve porosity.

The Examiner has asked about unexpected results. Attention has already been drawn to the statement in the paragraph bridging pages 4 and 5 of the present application. This states that "If the polymer is mixed with the solvent first, and the non-solvent then added to the solution, this generates a microgel, so the solution is unstable and does not give reproducible membranes."

On page 6 of the present application, with reference to the present invention, it is stated that:

- during solvation, gel formation is negligible and microgel formation does not occur (lines 20-23). This is based on light scattering experiments using polarized light to show the presence or not of a microgel;
- the solution is stable at room temperature for several weeks, its viscosity does not change, it forms reproducible membranes with consistent properties, and it is not necessary to cast the solution into a film immediately (lines 25-33).

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Also, Applicants have provided, in the application, seven detailed examples of the invention in which thin, porous membrane films of measured properties were made according to the invention under a range of process conditions.

In view of the foregoing amendments and remarks, Applicants submit that the claims, as amended, patentably distinguish over the cited art for the reasons set forth above. Accordingly, reconsideration of the application is requested and allowance of claims 1-13 is courteously solicited.

A required one-month extension of time is requested in a separate paper filed herewith.

Respectfully submitted,

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Date

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I hereby certify that this correspondence is being transmitted by facsimile this day to Examiner Michael Bernshteyn at the United States Patent and Trademark Office, Art Unit 1713, to fax No. 571-273-8300.

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Signature